Program Element : Carbon production and Water Quality Monitoring for Liberty Island

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I. Program Management

A. Program Description/Problem Definition

1.History

Liberty Island is one of a series of islands that feed water into the Yolo Bypass floodplain, a potentially important for area for wildlife and fishery production in the estuary (Sommer et al. 2001a). Future restoration plans include reducing the height of the levees between the islands that feed into Yolo Bypass in order to facilitate movement of water into the floodplain.

No information is currently available on the water quality and carbon production processes associated with Liberty Island. This information is needed to determine whether the restoration program at Liberty Island will be beneficial to downstream fishery production.

Enhancing fishery production is a major goal of CALFED restoration efforts because of the long-term decline in fishery production in the estuary over the last 30 years (Bennett and Moyle 1996). New research has demonstrated enhanced production of some fishery resources in floodplain habitat (Sommer et al. 2001b).

2. Purpose

The purpose of this study is to gain pre-project data on the water quality of Liberty Island and its material flux into adjacent islands. This information will be used to now to evaluate the current impact of the island on ecosystem process and estuarine production and in the future to asses the success of the restoration program currently being developed by SAFCA.

This project will be determined a success if the research data provides sufficient information to decide if the Liberty Island restoration program was beneficial to water quality conditions and fisheries production in the Sacramento-San Joaquin Delta.

3. Data and information from the program element will be used by CALFED and local agencies to develop management plans for fishery and wildlife restoration in the Sacramento-San Joaquin Delta.

4. This project has significant biological implications because the planned restoration program may enhance both total and native fish production.

B. Project Organization and responsibilities

This program element will be the responsibility of Dr. P. W. Lehman and will be conducted in collaboration with the zooplankton (L. Mecum) and continuous monitoring element (D. Kalff).

C. Study Design

1. Research questions:
   A. Discrete water quality sampling program
      1.0 Does the island create potentially beneficial water quality conditions for food web production?
         - What sub-habitats in LI are potentially more beneficial for phytoplankton and organic carbon?
         - Does LI produce sufficient quantity and quality of particulate organic matter including phytoplankton to support lower food web production, particularly zooplankton production?

      2. Does LI produce high quantities of trihalomethane (THM) precursors that can adversely affect human health downstream?
         - Do any sub-habitats in the island produce more precursors than others?

   B. Net material transport
      1. Does LI export water quality conditions such as low dissolved oxygen, total suspended solids or salinity that could be potentially harmful to food web production in adjacent areas?
      2. Does LI export organic matter food sources e.g. phytoplankton and organic carbon that are beneficial to food web production in adjacent river channels?
         - Is LI a source or sink of organic carbon and other materials to downstream areas?

      3. Is LI a source or sink of THM precursors that could potentially harmful to human health downstream?

   C. Methodology
      1. What are the best ways to sample the influence of LI on water quality conditions and lower food web production in the estuary?

2. Methods
   A. Discrete water quality sampling program
      1. Methods – Physical and chemical water quality variables will be measured quarterly at six stations representing different habitats: shallow water, channel

and emergent vegetation. Physical conditions including water temperature (°C), specific conductance (uS cm^{-1}), water transparency (m^{-1}), dissolved oxygen (mg L^{-1}) and pH. Water samples for nutrient analysis including ammonia, orthophosphate, silica, and nitrate plus nitrite concentration (mg L^{-1}) will be filtered through 0.45 um pore size Nucleopore filters and frozen until analysis (EPA 1983). Water samples for total phosphorus, turbidity, volatile suspended solids, total Kjeldahl nitrogen suspended solids and chloride (mg L^{-1}) will be kept cold at 4°C until analysis within 24 hr (APHA 2000; EPA 1983).

Organic matter production will be determined from a number of variables. Chlorophyll *a* and phaeophytin concentration (ug L^{-1}) will be determined from particulate matter filtered onto 0.45 um pore size glass fiber filters, preserved with magnesium carbonate and frozen until analysis (APHA 2000). Water samples for phytoplankton species identification, cell diameter (um) and enumeration (cells L^{-1}) will be placed in 50-ml glass bottles with 1 ml of Lugols stain and preservative. These samples will be kept cool and in the dark until analysis by the inverted microscope technique, 750X. Phytoplankton production and respiration rate (mg C $m^{-2}hr^{-1}$) will be determined from light and dark bottle incubation techniques using stable carbon isotopes and dissolved oxygen. incubation technique. Water samples for total and dissolved (filtrate from 0.45 um pore size filter). Total and dissolved organic carbon will be preserved with phosphate buffer and analyzed within 24 hr (APHA 2000). Replication for all variables will be at least 10% and follow the QA/QC procedures at the DWR Bryte Chemical Laboratory. THM potential will be measured by a contract laboratory service.

High frequency spatial variation of chlorophyll *a* biomass and water quality conditions will be measured by horizontal tows of a YSI 6600 water quality profiler throughout the island.

2. Analysis – Yearly and seasonal differences in the mean and variance of water quality conditions among stations will be described graphically and quantified with nonparametric statistical techniques, including the Kruskal-Wallis multiple comparison test. Comparisons of the mean and variance will also be made between measured values in this one-year study and historical data for similar water-year types. In addition, total annual organic matter production will be calculated as a function of surface area.

The importance of these differences to biological production will be evaluated in collaboration with other researchers in this program, particularly the zooplankton study element.

B. Net material transfer

1. Method – Net tidal-day transfer of material from the island into adjacent areas will be measured by discrete water quality sampling on ebb and flood tide

during spring and neap tidal cycles at the levee breaches. Sampling over the 25-hr tidal cycle will be facilitated by use of ISCO automated water sampler. Replication will be at least10%. Water quality measurements will include dissolved ammonia, natrate plus nitrite, orthophosphate and silica concentration, chlorophyll *a* concentration, total and dissolved organic carbon, phytoplankton species composition, total and volatile suspended solids, chloride and total phosphorus (See above for analytical methods).

2. Analysis – The net tidal day transfer will be calculated by multiplying the concentration or value of each water quality variable times the flow velocity at each levee break. Values will be integrated over a 30 – min time step and summed over the day to obtain a net value. Differences in material load between seasons and tides will be evaluated using nonparametric statistical tests, including the Kruskal-Wallis test.

D: Project Resource Needs

1.Budget

- Water quality and phytoplankton discrete sampling $35,432.
- Trihalomethane and organic carbon production and net transport studies $71,230.

2. Additional needs: 1) a pontoon boat will be needed for sampling and 2) 2 scientific aids will be needed for field sampling. The cost is covered in the budget.

E. ESA Considerations

This element of the PI program will not result in any take of endangered species.

F. Due dates and products

1. The program element will continue from one year of the start date of the project. This is estimated to be fall 2005.
2. This program element will produce quarterly fiscal and programmatic reports and a final report summarizing the data collected and findings of the study. A final quality checked data set containing the data collected during the study will be submitted for inclusion on the IEP server.

II. Program element measurement and data acquisition

A-E. See Methods section in C. Study Design

F. Data reduction – Data reduction, analysis and publication will be done by or directed by Dr. P. Lehman. The validity of statistical results will be determined by comparisons of a number of techniques and expert technical judgment.

III. Data Assessment and oversight

A and C. QC data checks – will be based on expert knowledge expert knowledge of the range of values possible. Outliers will be removed only if they are obvious errors. All decisions regarding data quality will be made by the principal investigator.

B. Laboratory data will be evaluated by QAQC procedures employed by the CDWR Bryte Chemical laboratory and will be under the direction of the laboratory director.

IV. Data validation and usability

A. **Error checking** will be done by the principal investigator with assistance from staff.
B. **The water quality** data are sound measurements that have no limitations in use.

References

Bennett W. A. and P. B. Moyle. 1996. Where have all the fishes gone? Interactive factors producing fish declines in the Sacramento-San Joaquin Estuary, p. 519-542. In J. T. Hollibaugh [ed.], San Francisco Bay: The Ecosystem. Pacific Division of the American Association for the Advancement of Science, San Francisco, California 94118.

Sommer, T. R., W. C. Harrell, M. Nobriga, R. Brown, P.B. Moyle, W. J. Kimmerer and L. Schemel. 2001a. California's Yolo Bypass: evidence that flood control can be compatible with fish, wetlands, wildlife and agriculture. Fisheries 26(8): 6-16.

Sommer, T. R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001b. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences 58(2): 325-333